Porous Silicon for Enhanced Detectors

Completed Technology Project (2013 - 2015)

Project Introduction

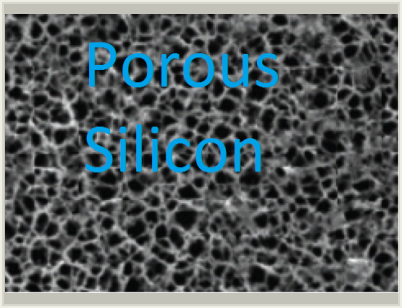
The very large surface area to volume ratio, and tunable thermal and optical properties provides a unique and adaptable material to push the performance of next generation sensors, MEMS devices, and optical components. In FY2015 we will continue to characterize the thermal properties of porous silicon and use this data to build a low thermal conductivity support structure for a prototype bolometer detector. This will provide a basis for higher performance and higher fill-factor detector arrays for future NASA missions In addition, we will explore the optical properties of the etched porous silicon layers to construct a multilayer infrared filter which has general applicability for Mid-IR and Terahertz instruments.

In FY2015, we will move forward with proof-of-concept devices that will show the feasibility of exploiting porous silicon for its thermal and optical properties. Porous Silicon is formed by an electrochemical etch of a silicon surface in a solution of a hydrofluoric-acid-based electrolyte. The etching process turns the crystalline solid into one with a network of nano-capillaries creating nanopores of varying surface to volume ratio depending on the selected conditions. The porosity of the silicon may be varied over a wide range.

We have two cross cutting goals for the coming year. First, we will build a simple support structure for a single pixel bolometer prototype that incorporates porous silicon with high critical temperature pixels. The electrical routing between the pixel and the support will be done with high resolution gold patterning. We will also continue to explore the multilayers of porous silicon and silicon structures. We will begin rigorous characterization to study how well the thickness and refractive index can be controlled.

Anticipated Benefits

Next Generation NASA Missions that use cryogenic detector arrays



Sample Porosity 70%

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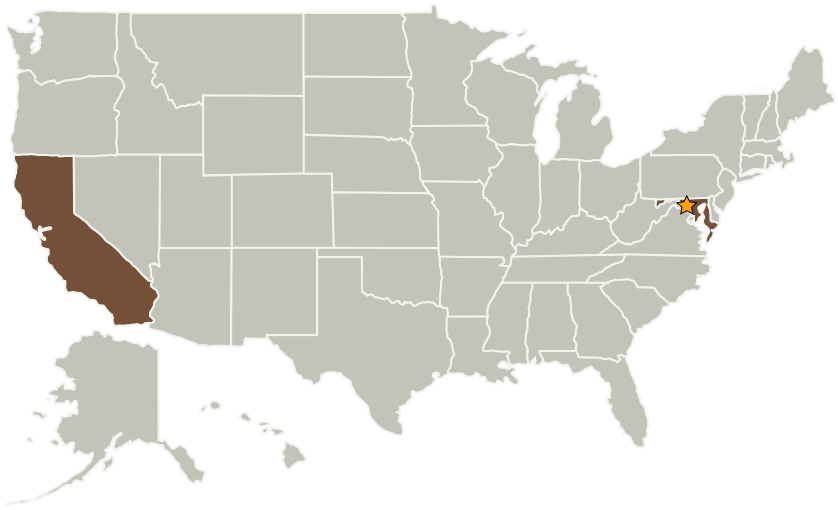
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland
University of California-Berkeley(Berkeley)	Supporting Organization	Academia	Berkeley, California
University of Maryland-College Park(UMCP)	Supporting Organization	Academia	College Park, Maryland

Primary U.S. Work Locations	
California	Maryland

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Manager:

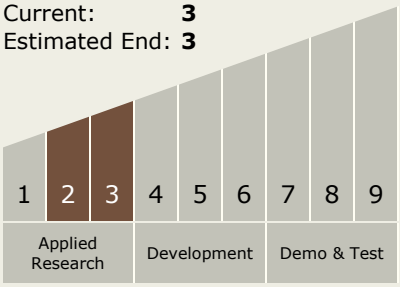
Terence A Doiron

Principal Investigator:

Larry A Hess

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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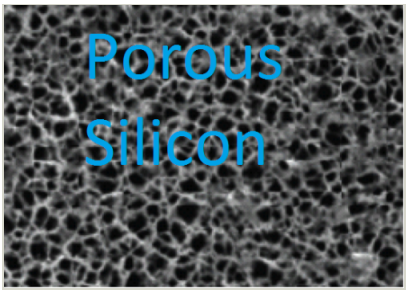
Images



SEM image of Porous Silicon
Sample Porosity 70%
(https://techport.nasa.gov/image/4228)

Links

GSC-17348-1
(no url provided)

Project Website:

http://aetd.gsfc.nasa.gov/

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes